



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA 92037

28 April 2006

CRUISE REPORT

VESSEL: NOAA Ship *McArthur II*

CRUISE NUMBER: AR-05-04 and AR-05-06, Southwest Fisheries Science Center Cruise Number 1627

CRUISE DATES: 4 June to 13 June 13, and 5 July to 24 July 2005

PROJECT: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (CSCAPE 2005)

STUDY AREA: United States West Coast waters

The principal study area included the U.S. West Coast Exclusive Economic Zone (EEZ) – Washington, Oregon, and California coastal waters out to a distance of approximately 300 nautical miles. The survey was divided into two sampling strata: 1) a grid of predetermined tracklines to obtain coarse coverage of the entire study area, 2) a separate set of parallel or zigzag lines to obtain finer-scale coverage within waters of four West Coast National Marine Sanctuaries.

ITINERARY: The CSCAPE project was divided into 8 legs. Legs 1a (AR-05-04) and 1b (AR-05-06) were conducted aboard NOAA Ship *McArthur II* and are covered in this report. Legs 2 through 7 were conducted aboard NOAA Ship *David Starr Jordan* and are covered in a separate cruise report.

Legs completed aboard NOAA Ship *McArthur II* include:

Leg 1a – Depart: 04 June, Astoria, OR	Arrive: 13 June, Port Angeles, WA
Leg 1b – Depart: 5 July, Seattle, WA	Arrive: 24 July, San Francisco, CA

SPONSORING INSTITUTIONS: Protected Resources Division, Southwest Fisheries Science Center, (NMFS, NOAA); Olympic Coast National Marine Sanctuary, Cordell Banks National Marine Sanctuary, Gulf of the Farallones National Marine Sanctuary, Monterey Bay National Marine Sanctuary (NOS, NOAA), and the Sanctuary Integrated Monitoring Network (SIMoN).

CRUISE DESCRIPTION AND OBJECTIVES: The CSCAPE 2005 cruise was a collaborate survey between the National Marine Fisheries Service and the National Marine Sanctuary Program to assess the abundance and distribution of cetaceans and to characterize the pelagic ecosystem off the U.S. West Coast. The primary objective was to conduct a cetacean assessment survey out to a distance of approximately 300 nautical miles, with additional fine-scale surveys within the NMS boundaries. A secondary objective was to characterize the pelagic ecosystem within the study area, through the collection of underway and station-based physical and biological oceanographic sampling, studies of mid-trophic level organisms (using net sampling and acoustic backscatter methods) and research on non-protected apex predators (seabirds). A final objective was to conduct biopsy sampling and photo-identification studies of cetacean species of special interest.

CHIEF SCIENTIST: Dr. Karin Forney, SWFSC (831) 420-3908



1.0 PROCEDURES FOR DAYLIGHT OPERATIONS

1.1 Cetacean Survey - Line-transect survey methods were used to collect abundance data. Search effort started on the trackline at the beginning of each day. NOAA Ship *McArthur II* traveled at 10 knots (through the water) along the designated trackline. If the ship's speed through the water deviated from this by more than one knot while on search effort, the bridge personnel notified the mammal team on watch or the Cruise Leader. A daily watch for cetaceans was maintained on the flying bridge during daylight hours (approximately 0600 to 2030) by 6 mammal observers. Each observer worked in 2-hour rotations, manning each of the following 3 stations on the flying bridge for 40 minutes: a port side 25x150 binocular station, a center-line data recorder position, and a starboard 25x150 binocular station. An "independent observer" kept a separate watch of animals sighted during the cetacean survey operations, to be compared later with the observer team's data.

1.1.1 Logging of Data - Observation conditions, watch effort, sightings and other required information were entered into a computer, hooked up to the ship's Global Positioning System (GPS; course, speed and position information) and Scientific Computing System (SCS; weather and heading information). All science computers were connected to the same ship's GPS.

1.1.2 Breaking Trackline - On sighting cetaceans or other feature of biological interest, the Cruise Leader or marine mammal observer team on watch requested that the vessel be maneuvered to approach the school or feature for investigation. When the ship approached a group of cetaceans, the observers made independent estimates of school size. Biopsy and photographic operations commenced from the bow, based on directions from the Cruise Leader or Senior Marine Mammal Observers. The Cruise Leader frequently requested the deployment of a small boat for biopsy, photographic, or other operations (see 1.3). Occasionally, it was necessary to divert the ship's course from the established trackline during regular effort due to glare or adverse sea conditions. Under these circumstances, the ship was diverted up to 30 degrees from the established course. This deviation was continued until the ship was 5 nautical miles from the trackline, at which point the ship turned back toward the trackline.

1.1.3 Resuming Effort - When the observers completed scientific operations for the sighting, the ship resumed the same course and speed as prior to the sighting. If the pursuit of the sighting took the ship more than 5 nautical miles from the trackline, the observers were notified. The Cruise Leader or Senior Marine Mammal Observers infrequently requested that, rather than proceed directly toward the next waypoint, the ship take a heading of 20 degrees back toward the trackline or return to the position at which the ship diverted before resuming effort.

1.2 Seabird Survey - Visual surveys of seabirds were conducted from the flying bridge during daylight hours by two seabird observers. Sighting conditions, effort, sightings and other required information were entered into a computer interfaced with the ship's GPS (course, speed and position information) and SCS (weather and heading information). All science computers were connected to the same ship's GPS. Seabird observers used handheld and 25x150 binoculars.

1.3 Small Boat Work - A small boat was frequently required for biopsy sampling or photography. Deployment was requested by the Cruise Leader on an opportunistic basis during all daylight hours, sometimes multiple times in a single day, providing the Commanding Officer concurred that operating conditions were safe. Unless the Commanding Officer allowed otherwise, the small boat remained within sight and radio contact at all times while deployed. With the exception of the small boat and required safety gear, all necessary gear was furnished by the scientific party.

1.4 Biopsy Sampling - Biopsy samples for genetic analyses of cetaceans were collected frequently on this survey. Necessary permits were present on the vessel. The animals sampled were approached by the research vessel during normal survey operations, approached the vessel on their own, or were approached by a small boat. Samples were collected using a dart fired from a crossbow or rifle when the animals were within 10 to 30m of the bow of the vessel. With the exception of the small boat and safety gear, all necessary gear was furnished and operated by the scientific party.

1.5 Photography - Photographs of cetaceans were taken frequently on this survey. Necessary permits were present on the vessel. The animals to be photographed were approached by the research vessel during normal survey operations, approached the vessel on their own, or were approached by a small boat. With the exception of the small boat and safety apparel, all necessary gear was furnished by the scientific party.

1.6 Collection of Fish - Fish were collected on an opportunistic basis at the discretion of the Cruise Leader. Trolling gear was used underway when conditions permitted. While stationary, hook-and-line gear was used. Fish were measured, sexed, and stomach contents were examined and recorded by scientific personnel. The Cruise Leader was responsible for the disposition of the catch, in accordance with NOAA Administrative Order 202-735B, dated January 9, 1989.

1.7 Collection of Jellyfish Samples - Jellyfish and other gelatinous plankton were collected for leatherback turtle dietary studies. Jellyfish were collected during scheduled bongo tows or from the small boat. Samples were frozen for future stable isotopic analysis.

1.8 Salvage of Cetaceans and Birds - Permits to salvage and import cetacean and bird parts were present on the vessel; however, no cetacean or bird parts were salvaged during this cruise.

1.9 Acoustics - The scientific EK-60 depth sounder was operated continuously at 38, 120 and 200 KHz and was interfaced to a data acquisition system to estimate micronekton biomass between 0 and 500m. The vessel's navigational depth sounder normally remained off while underway in deep waters, and the command informed the Cruise Leader at any time when navigational depth sounders were used.

1.10 Oceanography - Oceanographic sampling was done by the Oceanographer, ship's Survey Technician, and other designated scientists, while underway.

1.10.1 XBT Drops - XBT drops were conducted three times per day during leg 1a (at 1000, 1400 and 1800 hours local ship time), and four times per day during leg 1b (at 0900, 1200, 1500, and 1800 local ship time), or as requested by the Cruise Leader. The XBTs were provided by SWFSC, and the launcher/computer was provided by the ship. XBTs were conducted by one person per drop (either by a member of the scientific party or by the Survey Technician). At least one drop per day was conducted by the ship's Survey Technician. If the vessel was stopped at the scheduled launch time, the drop was delayed until the ship was underway again. If the vessel did not move within half an hour, the individual performing the drop was notified and the drop was delayed or canceled, at the discretion of the Cruise Leader.

1.10.2 Surface Water Samples - A surface water sample for chlorophyll *a* analysis and a bucket temperature were taken at 0900, 1200, 1500 and 1800 hours local ship time daily, or as requested by the Cruise Leader. These samples were taken by either a member of the scientific party or the Survey Technician.

1.10.3 Thermosalinograph Sampling - The ship provided and maintained a thermosalinograph (TSG), which was calibrated and in working order, for continuous measurement of surface water temperature and salinity. The Scientific Computing System (SCS) served as the main data collection system. The Oceanographer provided the ship's Operations Officer and Electronics Technician with detailed SCS

acquisition information before departure and a member of the scientific party sailing on the initial transit provided additional technical support. The SCS data acquisition was stopped and restarted weekly so the data files could be backed up and checked for errors. All SCS data was provided to the SWFSC Oceanographer following each leg of the cruise.

2.0 PROCEDURES FOR NIGHT OPERATIONS

A chronological record of oceanographic and net tow stations was kept by ship personnel (Marine Operations Log) with dates and times in GMT. Ship personnel provided a copy of the electronic marine operations log (with the cruise Weather Log and SCS data) to the SWFSC Oceanographer at the completion of the cruise. The main SeaBird CTD system was provided, maintained, and operated by the Survey Technician. The collection of oceanographic samples and their processing was conducted by the Oceanographer and Survey Technician. The crew of the vessel operated all deck equipment and was responsible for the termination (and any necessary reterminations) of the CTD cable pigtail to the conducting cable of the winch. The ship provided a complete backup system, consisting of a frame with weights, 12-place rosette with bottles, a deck unit, and a SeaBird 9/11+ CTD with conductivity and temperature sensors. All instruments, their spares, and spare parts provided by the ship were maintained in working order and, if applicable, had current calibrations (within the previous 12 months).

2.1 CTD Stations - Weather permitting, between one and two CTD stations were occupied each night: an evening cast after the end of effort (unless the ship would resume effort within 10 nautical miles the next morning), and a pre-dawn cast. CTD data and seawater samples were collected using a SeaBird 9/11+ CTD with rosette and Niskin bottles fitted with silicone tubing and o-rings (supplied by Oceanographer). All casts are to 1000m, with the descent rate at 30m/min for the first 100m of the cast, then 60m/min after that, including the upcast between bottles. Cast times were subject to change because sunrise and sunset times varied during the cruise.

2.1.1 Pre-daylight Cast - The morning cast (1000m) began approximately one and one-half hours prior to sunrise. The exact starting time was determined the evening before, by the Operations Officer or Deck Officer. The time did not change more than 15 minutes from the previous day, even if sunrise changed more than this. Niskin bottle water samples were collected at seven light depths and five additional standard depths, between the surface and 1000m. These depths were determined just prior to each cast by entering the ship's position into a computer program. From each cast, chlorophyll samples (to 200m) and salinity samples (2 to 6 samples per cast, at least 500 and 1000 m or bottom) were collected and processed on board. The 265ml chlorophyll samples were filtered onto GF/F filters, placed in 10ml of 90% acetone, refrigerated for 24 hours, and then analyzed on a Turner Designs model 10AU field fluorometer. Nutrient samples (0 - 500m) were collected, frozen, and stored on board. Both the Survey Technician and Oceanographer participated in sample collection (chlorophylls and nutrients) and analysis of chlorophyll samples. The Survey Technician and Oceanographer collected and analyzed salts and recorded them in the log provided, when one case of 24 bottles was full and had been temperature stabilized in the location of the salinometer. Primary productivity was measured by radioactively labeled carbon uptake methods performed by the Oceanographer. Seven samples taken from Niskin bottles #1 through #7 were spiked with ^{14}C , incubated on deck for 24 hours, and then filtered and stored for later analysis at the SWFSC. The Niskin bottles (#1-7) were rinsed after each cast and acid-washed at the end of each leg. In San Diego, the Oceanographer was trained by SWFSC personnel in the use of radioactive material prior to departure. A copy of the SWFSC's NRC license for the use of radioisotopes was kept on board. All radioactive waste was stored in secured drums and boxes, and returned to San Diego (i.e. no disposal of radioactive materials at sea).

2.1.2 Post Effort Cast - An evening CTD cast, to 1000m, was conducted, after effort, if the ship would move less than 10 nautical miles overnight. The exact time was determined by the Deck Officer

(by 1800 local ship time that day). Bottle samples were collected from 12 standard depths (0, 20, 40, 60, 80, 100, 120, 140, 170, 200, 500, 1000m). Samples for chlorophyll, nutrients and salts were taken as listed above (except for the addition of four salinity samples taken from every other evening cast).

2.2 Net Sampling - Net tows were conducted by the scientific party as assigned by the Cruise Leader, with the assistance of the Survey Technician and a winch operator from the vessel.

2.2.1 Bongo Tow - An oblique bongo tow was conducted after the post-effort CTD in darkness. If no evening CTD was conducted, then the tow was begun a minimum of one-hour after sunset. Both nets were 505 micron mesh and were towed for 15 minutes (45 minute station time), to a depth of 200m (wire out 300m on starboard hydro winch). The samples were preserved in formalin or frozen (isotope analysis), labeled and stored in containers provided by the SWFSC until the vessel returned to San Diego. The second cod end of the bongo (port side) was attached once per week or as requested by the Cruise Leader for isotope samples (see section 2.2.1.1).

2.2.1.1 Samples for Leatherback Turtle Diet Isotope Project - The gelatinous contents of the second cod end of the bongo were placed in whirl-paks, labeled, and stored frozen for later stable isotopic analysis. J. Seminoff (SWFSC) provided supplies to label and store these samples.

2.3 Sediment Samplings - At the discretion of the Cruise Leader, a Van Veen sampler was deployed at designated stations for Dr. S. Ian Hartwell, NOAA/NOS Center for Coastal Monitoring & Assessment. These samples were taken by two members of the scientific party and a winch operator. Surficial sediment material was removed with scoops from one sampler, homogenized, and apportioned to jars for chemical and physical testing at laboratories ashore. Chemical samples were frozen until the end of the cruise. Samples for physical testing were kept refrigerated and shipped on ice. The ship position was maintained as close as possible to target coordinates.

2.4 Transit - When scientific operations were complete for the night, the ship resumed course and proceeded along the trackline, until it was necessary to stop and position the ship for the morning CTD station. The ship transited between 5 and 100 nautical miles per night.

3.0 SCIENTIFIC PERSONNEL

3.1 Chief Scientist - The Chief Scientist was Dr. Karin Forney, SWFSC.

3.2 Participating Scientists -

NOAA Ship *McArthur II* - Leg 1a: Astoria, OR to Port Angeles, WA

Position	Name	Affiliation
Chief Scientist	Ed Bowlby	NMS
Senior Mammal Observer	Gary Friedrichsen	AFL
Senior Mammal Observer	Jim Cotton	SWFSC
Senior Mammal Observer	Juan Carlos Salinas	AFL
Mammal Observer	Annie Douglas	Cascadia Research
Mammal Observer	Michael Richlen	NMS
Mammal Observer	Barry Troutman	NMS
Independent Observer	Karin Forney	SWFSC
Seabird Observer	Cornelia Oedekoven	AFL
Seabird Observer	Scott Mills	NMS
Oceanographer	Elizabeth Zele	AFL
Oceanographer	Melinda Kelley	AFL
NMS Visiting Scientist/Seabird Observer	Barbara Blackie	NMS
NMS Visiting Scientist	Janet Lamont	NMS

Note: (SWFSC: Southwest Fisheries Science Center, AFL: Aquatic Farms, Ltd., NMS: National Marine Sanctuaries)

NOAA Ship *McArthur II* - Leg 1b: Seattle, WA to San Francisco, CA

Position	Name	Affiliation
Chief Scientist	Karin Forney	SWFSC
Senior Mammal Observer	Cornelia Oedekoven	AFL
Senior Mammal Observer	Jim Cotton	SWFSC
Senior Mammal Observer	Juan Carlos Salinas	AFL
Mammal Observer	Holly Fearnbach	AFL
Mammal Observer	Ernesto Vasquez	AFL
Mammal Observer	Tim O'Toole	AFL
Independent Observer	Jan Roletto	NMS
Seabird Observer	Rich Pagen	AFL
Seabird Observer	Sophie Webb	AFL
Oceanographer	Elizabeth Zele	AFL
Oceanographer	Melinda Kelley	AFL
NMS Visiting Scientist/Third Birder	Peter Pyle	NMS
Teacher-at-sea	Kimberly Pratt	NOAA Teacher-at-Sea
Visiting Scientist/Other	Sage Tezak	NMS

Note: (SWFSC: Southwest Fisheries Science Center, AFL: Aquatic Farms, Ltd., NMS: National Marine Sanctuaries)

4.0 RESULTS

The following summarizes the area surveyed and the data collected:

Figure 1: Tracklines surveyed during daylight hours for CSCAPE 2005.

Figure 2: Location of cetacean sightings during Leg 1a, CSCAPE 2005. Note sightings are plotted over the planned tracklines (gray).

Figure 3: Location of cetacean sightings during Leg 1b, CSCAPE 2005. Note sightings are plotted over the tracklines (blue).

Table 1: Summary of CSCAPE 2005 marine mammal sightings during Legs 1a and 1b.

Table 2. Number of cetacean biopsy samples collected during CSCAPE 2005 on Legs 1a and 1b aboard NOAA Ship *McArthur II*.

Table 3. Preliminary estimates of the number of cetacean photographs obtained during CSCAPE 2005, legs 1a and 1b (digital and some 35mm).

Table 4. Summary of environmental data collected during CSCAPE 2005 aboard *McArthur II*, Legs 1a and 1b.

5.0 DISPOSITION OF DATA

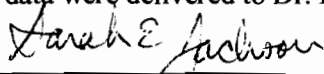
All data are currently being analyzed. The final data reports will be completed by 31 December 2006

Marine Mammal and passive acoustic data were delivered to the Chief Scientist, Dr. Karin Forney, SWFSC, for analysis and distribution.

Biopsy samples were delivered to Dr. Barbara Taylor, SWFSC, for analysis and distribution.

Oceanographic data were delivered to Dr. Paul Fiedler, SWFSC, for analysis and distribution.

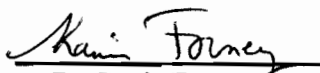
Prepared by:



LTJG Sarah E. Jackson
Survey Coordinator, SWFSC

Dated:

4/27/2006



Dr. Karin Forney
Chief Scientist, SWFSC

Dated:

4/28/2006

Approved by:



Dr. Stephen B. Reilly
Chief, Protected Resources Division

Dated:

5/3/06

Approved by:



Dr. William W. Fox, Jr.
Science Director, F/SWR

Dated:

5/5/06

Figure 1: Tracklines surveyed during daylight hours for CSCAPE 2005. Those tracklines relevant to this cruise report are shown in black (leg 1a) and purple (leg 1b).

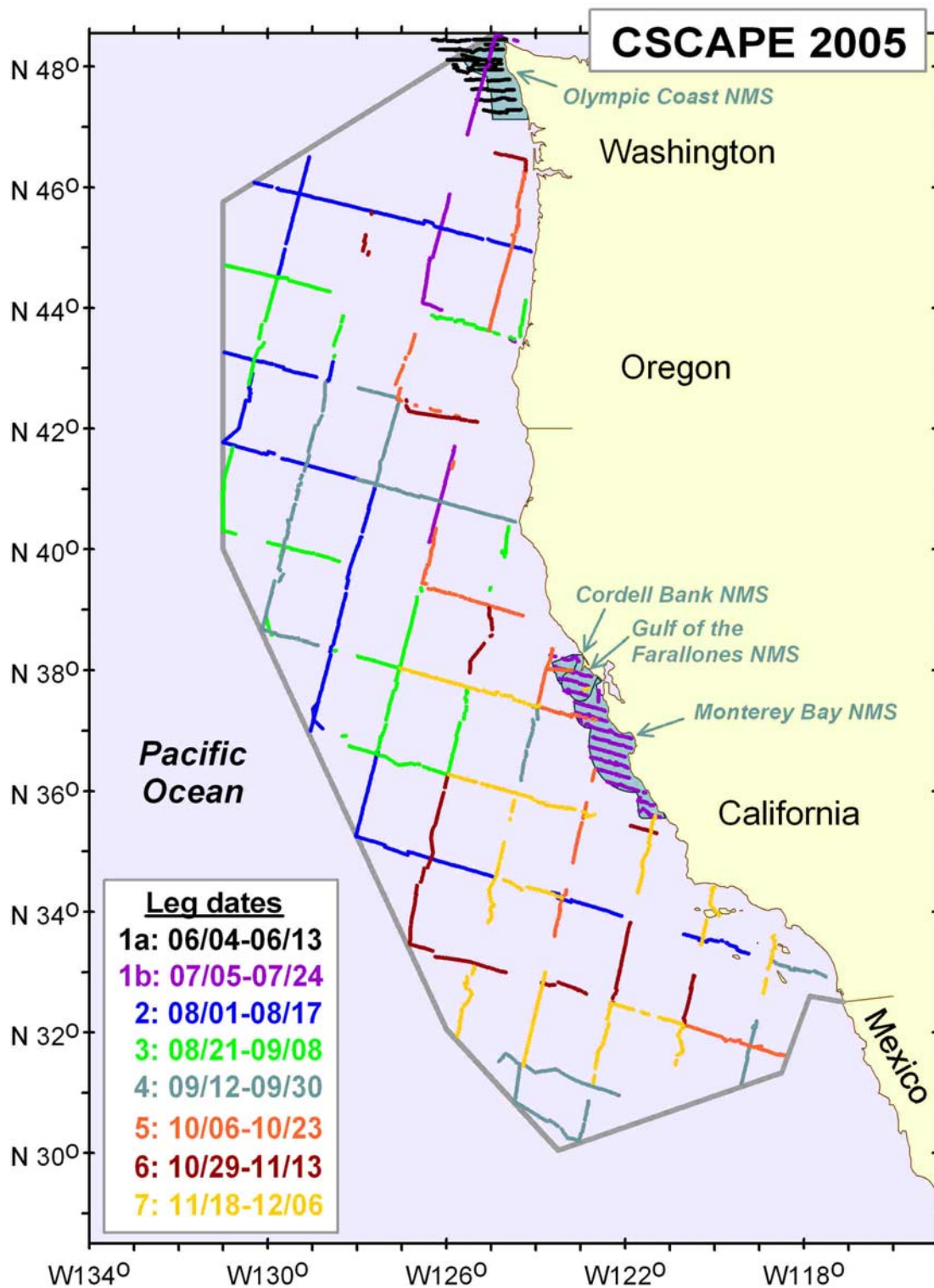


Figure 2: Location of cetacean sightings during Leg 1a, CSCAPE 2005. Note sightings are plotted over the planned tracklines (gray).

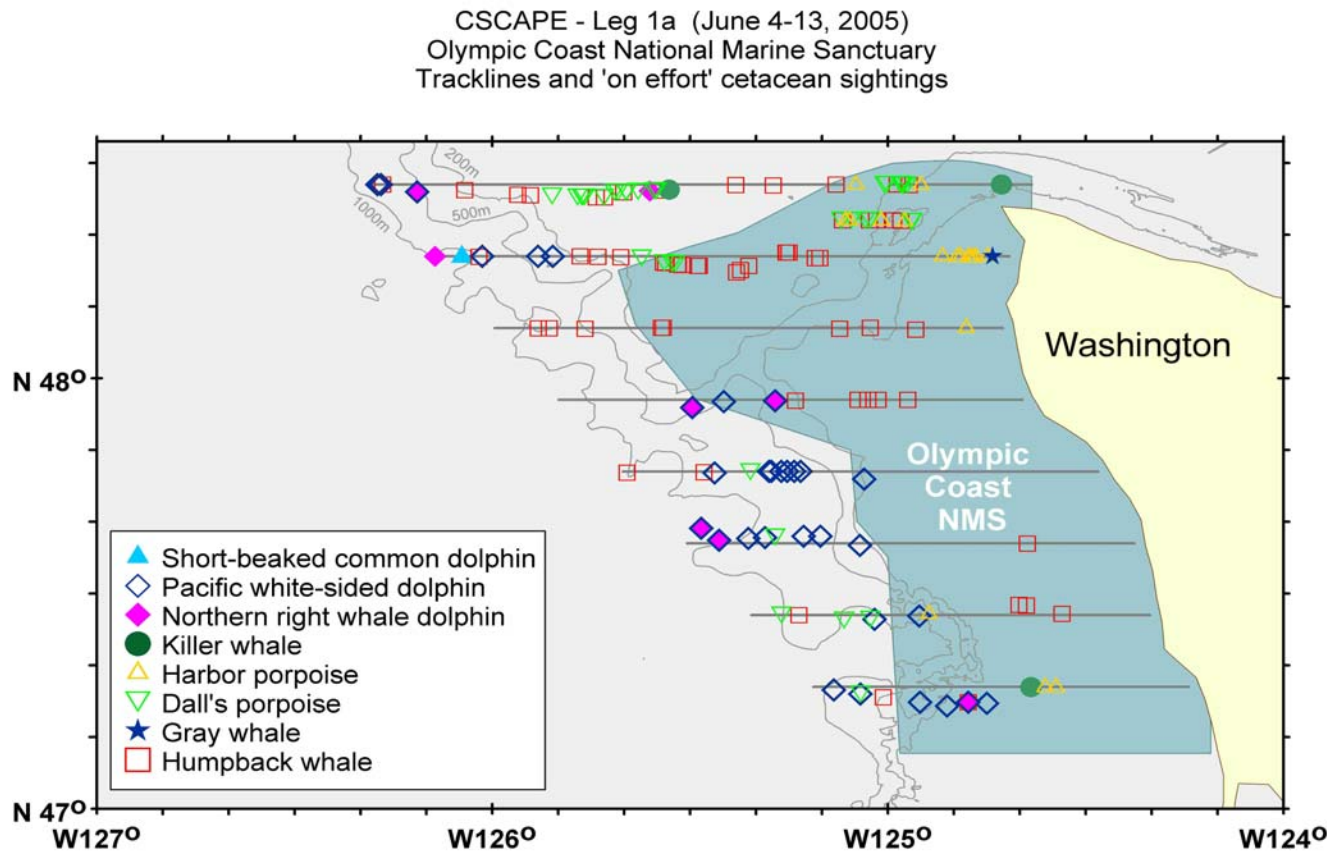


Figure 3: Location of cetacean sightings during Leg 1b, CSCAPE 2005. Note sightings are plotted over the tracklines (blue).

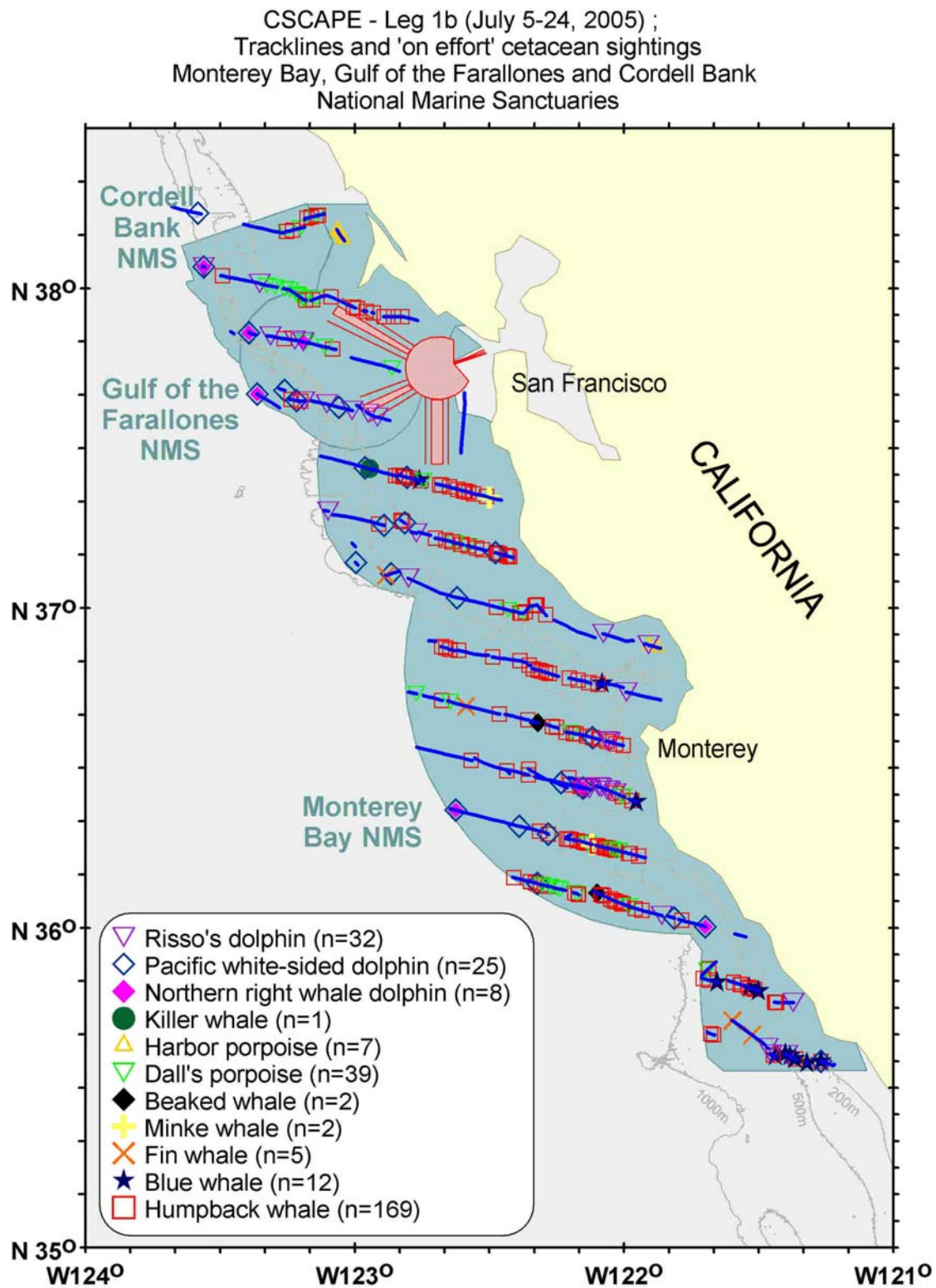


Table 1: Summary of CSCAPE 2005 marine mammal sightings during Legs 1a and 1b. Mixed schools are counted once for each sighting category that occurs in them. School size is the mean of the best estimates of total school size for pure schools, and subgroup size of the sighting category in the case of mixed schools.

Code	Sighting Category	Pure schools	Mixed Schools	Total Sightings	Average School Size
17	<i>Delphinus delphis</i>	1	0	1	38
21	<i>Grampus griseus</i>	44	5	49	16.2
22	<i>Lagenorhynchus obliquidens</i>	64	23	87	25.9
27	<i>Lissodelphis borealis</i>	4	21	25	60.6
37	<i>Orcinus orca</i>	8	0	8	3.6
40	<i>Phocoena phocoena</i>	57	0	57	2.4
44	<i>Phocoenoides dalli</i>	125	2	127	3.3
46	<i>Physeter macrocephalus</i>	4	0	4	1.5
49	ziphiid whale	1	0	1	2
51	<i>Mesoplodon</i> sp.	4	0	4	1.8
61	<i>Ziphius cavirostris</i>	2	0	2	2.7
69	<i>Eschrichtius robustus</i>	2	0	2	1
70	<i>Balaenoptera</i> sp.	3	1	4	1
71	<i>Balaenoptera acutorostrata</i>	7	0	7	1
74	<i>Balaenoptera physalus</i>	15	1	16	1.2
75	<i>Balaenoptera musculus</i>	24	2	26	1.3
76	<i>Megaptera novaeangliae</i>	351	8	359	1.5
77	unid. dolphin	27	2	29	38.7
78	unid. small whale	1	0	1	1
79	unid. large whale	36	0	36	1.3
96	unid. cetacean	2	0	2	2
277	unid. medium delphinid	0	1	1	5.1
CU	<i>Callorhinus ursinus</i>	122	0	122	1.4
EJ	<i>Eumetopias jubatus</i>	5	0	5	1.2
MA	<i>Mirounga angustirostris</i>	41	0	41	1
PU	unid. pinniped	17	0	17	1.1
PV	<i>Phoca vitulina</i>	13	0	13	1
ZC	<i>Zalophus californianus</i>	96	0	96	2.1
EL	<i>Enhydra lutris</i>	7	0	7	1.1
	TOTAL	1083	66	1149	6.5

Table 2. Number of cetacean biopsy samples collected during CSCAPE 2005 on Legs 1a and 1b aboard NOAA Ship *McArthur II*.

Scientific Name	Leg 1a	Leg 1b
<i>Lagenorhynchus obliquidens</i>	8	7
<i>Lissodelphis borealis</i>	2	3
<i>Orcinus orca</i>	0	5
<i>Phocoenoides dalli</i>	0	3
<i>Physeter macrocephalus</i>	0	11
<i>Balaenoptera physalus</i>	0	1
<i>Balaenoptera musculus</i>	0	4
<i>Megaptera novaeangliae</i>	12	6
Unid. small delphinid (<i>Lagenorhynchus obliquidens</i> or <i>Lissodelphis borealis</i>)	0	2
Total	22	42

Table 3. Preliminary estimates of the number of cetacean photographs obtained during CSCAPE 2005 Legs 1a and 1b aboard NOAA Ship *McArthur II*. (digital and some 35 mm).

Species	Category	Leg 1a	Leg 1b	Total
<i>Megaptera novaeangliae</i>	catalogue-quality flukes	40	42	82
<i>Balaenoptera musculus</i>	dorsal	0	20	20
<i>Balaenoptera physalus</i>	dorsal	0	7	7
<i>Physeter macrocephalus</i>	fluke	0	14	14
<i>Orcinus orca</i>	dorsal	37	16	53
<i>Lissodelphis borealis</i>	groups photographed	4	2	6
<i>Lagenorhynchus obliquidens</i>	groups photographed	5	7	12
<i>Grampus griseus</i>	groups photographed	0	7	7
<i>Phocoenoides dalli</i>	groups photographed	0	2	2
Total		86	117	203

Table 4. Summary of environmental data collected during CSCAPE 2005 aboard *McArthur II*, Legs 1a and 1b.

	Leg 1a	Leg 1b	Total
CTD casts	10	21	31
CTD chlorophyll samples	67	178	245
Surface chlorophyll samples	18	54	72
Primary productivity samples	49	98	147
Nutrient samples	81	216	297
Salinity samples	42	86	128
XBT drops	21	53	74
Bongo Tows	6	13	19